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SUMMARIES OF SOVIET PAPERS ON METALLURGY

[Comment: The following are summaries of six papers in Trudy Moskovskogo Aviatsionnogo Tekhnologicheskogo Instituta (Transactions of the Moscow Aviation Technological Institute), No 4, 1948, published by the State Publishing House for Defense Industry. The issue was edited by Professor S. M. Veronov, Doctor of Technical Sciences.]

1. "Investigation of Certain Methods of Treating Elektron in Liquid State," by Docent V. M. Sharov, Engineer A. P. Gudchenko, and Engineer M. G. Stepanova, pp 3-31, seven references

The authors studied the behavior of ML5, the Elektron-type alloy widely used in the USSR, under various treatments. They investigated the factors which have an effect on the grain size and mechanical properties of this alloy, as follows: superheating at various temperatures, remelting and scrap additions, length of grain refining period, inoculation with solid aluminum or alloy of the same composition, treatment with ferric chloride, and additions of iron in the form of aluminum-base master alloy. Some of the authors' conclusions are as follows:

Favorable effect of heating on the properties of the alloy is already noticeable at 700°. The lower the temperature, the longer should be the holding period for obtaining better results, which show still further improvement with a temperature increase up to 850°. Further rise in temperature has no improving effect on the metal. Holding at 850° for 15 minutes, rapid cooling, and immediate pouring are recommended as the optimum procedure for alloy treatment by superheating. Prolonged holding of metal at temperatures above 800° may impair the mechanical properties owing to contamination of the alloy with oxides.

Remelting improves the mechanical properties of the alloy, which attain their maximum after three remeltings. In further remelting, the mechanical properties get worse despite further grain refinement.

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Addition of scrap or secondary metal improves alloy properties. The maximum effect is usually reached at 25% addition, being maintained up to 75% of secondary metal in alloy; but a still higher scrap content may cause lower mechanical properties.

Remelting and scrap addition do not improve the alloy so much as some other methods. Alloys remelted or those made out of charge containing scrap may be subjected to further refinement. Additional treatment, by superheating for example, may sometimes improve the properties of an alloy to a greater extent than can be done by refinement of the primary alloy alone.

Addition of solid metal into the melt improves the properties of the alloy if the temperature of the molten metal at the moment of addition does not exceed 750°. This practice is not a very effective measure, acting approximately similarly to the remelting and scrap addition, but it is simple and permits repetition.

Introduction of ferric chloride into a melt at 750° with subsequent heating of the melt to 820° results in a grain refinement which could not be obtained by any other method; the productive capacity of furnaces in this case is higher than in the case of superheating. However, the application of ferric chloride is a hazardous operation because during its introduction the molten metal is splashed out of the crucible. Therefore, this method can not be recommended until protective measures are developed.

2. "Corrosion Resistance of Nitrided Ferrous Alloys," by Professor I. Ye. Kontorovich, Doctor of Technical Sciences, and Docent A. A. Sovalova, Candidate of Technical Sciences, pp 32-50, six references

The main task of this work was a study of the electrochemical properties of iron and steel saturated with nitrogen, an investigation of the effect of the phase state of the metal surface layer on its corrosion resistance, and an establishment of the optimum conditions of nitriding Armco-iron and steels 38KhMyuA and 30KhMA for obtaining the most stable surface.

The first part of the paper deals with determining the electrode potentials relative to nitrogen concentration. On the basis of measuring the potentials of iron in sea water, the authors conclude that the phases and mixtures of phases rich in nitrogen have the highest potential, that the epsilon-phase is most electropositive having a potential of 0.10-0.13 V, and that potential variation in a single-phase zone is insignificant. Results of the measurements are presented in diagrams [not included in this report].

The second part of the article describes corrosion tests which resulted in establishing an optimum procedure for nitriding the metals under investigation to obtain maximum corrosion resistance of their surface. These optimum conditions are shown in the following table:

	Nitriding Temperature (°C)	Degree of NH ₃ Dissociation (%)	Nitriding Time (hours)
Armco-Iron	700	65	1-3
Same	700	70	1
KhMyuA Steel	600	65	1-3
Same	600	80	3

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Armco-iron and steel KhMYuA, nitrided under the conditions indicated showed complete resistance to corrosion upon testing in water from the public supply system, in benzine, in a 3% solution of NaOH, and under atmospheric conditions.

Tests in sea water demonstrated a comparatively higher corrosion resistance of the same metals in nitrided form as compared with their properties before nitriding.

All the results of the numerous corrosion tests were tabulated.

3. "Phase Transformations in the Iron-Nitrogen System," by Professor I. Ye. Kontorovich, Doctor of Technical Sciences, and Docent A. A. Sovolova, Candidate of Technical Sciences, pp 51-67

Stating that the construction of the Fe-N phase diagram is especially difficult since a number of universally adopted investigation methods are inapplicable in this case, the authors discuss the results of their metallographic and X-ray investigations into the structure of nitrided layers formed at various temperatures. They studied structure and size of the surface layers after slow cooling for obtaining entirely stable structures, and also after heat treatment for clarification of the structure at high temperatures and for establishing those transformations which occur in the process of hardening.

The authors compare a phase diagram constructed by O. Eizenhut and E. Kaupp with that by E. Lehrer, considering the latter as the correct diagram. This fact is, in their opinion, corroborated by intermittent increase of the epsilon-phase layer.

Several other conclusions made by the authors on the basis of their experiments are as follows:

The amount of absorbed nitrogen increases smoothly to a temperature of 660°C, above which the increase in the amount of absorbed nitrogen acquires an intermittent character. The total depth of nitrogen penetration varies, depending on temperature. Microstructures of hardened metal indicate that sharp increase in depth and change of structure are caused by the phase transformations which take place during the holding period at high temperature.

The sequence of arrangement of various layers in the microstructure of nitrided iron quenched from 700°C is as follows: a layer of nitrides, nitrogenous austenite in the form of acicular crystals, nitrogenous austenite in the form equiaxial crystals, nitrogenous martensite, and nitrogenous ferrite.

The study of transformations during tempering established that the metastable microstructures in Fe-N and Fe-Fe₃N systems are alike to a considerable extent in their appearance and behavior on heating. Tempering at 250°C causes the following changes: nitrogenous austenite decomposes and darkens, nitrogenous martensite also darkens, and Fe₃N in the form of nitride needless is separated out of nitrogenous ferrite. Tempering at 350°C leads to complete dissociation of the structures of hardening.

4. "Concerning the Structural Transformations in Cast Irons," by Engineer S. V. Avakyan and N. F. Lashko, Candidate of Technical Sciences, pp 68-74

Assuming that structural transformations in cast iron during heating are accompanied by changes in the degree of heterogeneity, which factor affects the resistance of the metal to corrosion, the authors use the corrosion method of investigating the mechanism of structural transformations in cast irons.

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Results of heat treatment and corrosion tests of gray and white cast irons are graphically represented and discussed. One conclusion of the authors is that the resistance of cast iron to corrosion is basically conditioned by iron-cementite galvanic pairs; they thus dispute a generally accepted assumption according to which changes in the corrosion resistance of cast iron are caused by the formation of iron-graphite galvanic pairs.

5. "On the Conditions for Eutectic Formation," by Engineer S. V. Avakyan and N. F. Lashko, Candidate of Technical Sciences, pp 75-82, six references

Assuming that any eutectic alloy represents a conglomerate of crystallized separate phases coexisting in equilibrium, the authors develop formulas for determining the concentration of these phases. Analyzing the formulas obtained, they make two conclusions: (1) the eutectic point is shifted, depending on changes in conditions for the formation of phases, for example, when the cooling rate is changed; (2) the introduction of surface-active substances, which change the surface tension, also shifts the eutectic point. In particular, the second conclusion, they state, helps to clarify the modification process in Silumin, since it was experimentally established that the eutectic point in modified aluminum-silicon alloys is shifted as compared to nonmodified alloys.

6. "On the Causes of Surface Defects on Rods Extruded Out of Aluminum Alloys," by S. N. Tarantov, Candidate of Technical Sciences, pp 83-116, two references

The author discusses various defects, such as blisters, flaws, fissures, etc., occurring in the process of extrusion by direct and reverse methods, with or without lubrication. He also analyzes the causes of these defects and suggests some corrective measures.

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